

DEVELOPMENT OF A CREW HEALTH AND PERFORMANCE SYSTEM PROBABILISTIC RISK ASSESSMENT TOOL: PROOF- OF-CONCEPT APPROACH

2023 NASA HRP Investigators Workshop

Jerry Myers¹

Raj Prabhu²

Beth Lewandowski¹

Drayton Munster¹

Ian Milray¹

Suleyman Gokoglu¹

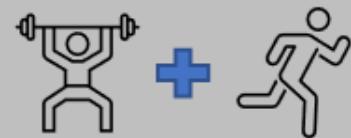
Courtney Schkurko¹

Mona Matar¹

¹NASA GRC

²NASA JSC

Consider this CHP-PRA Scenario



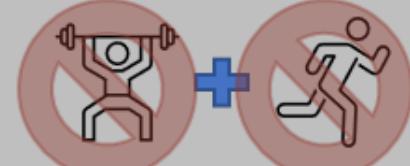
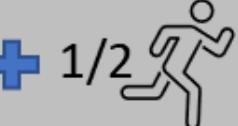
Reduce
Mass
and
Volume



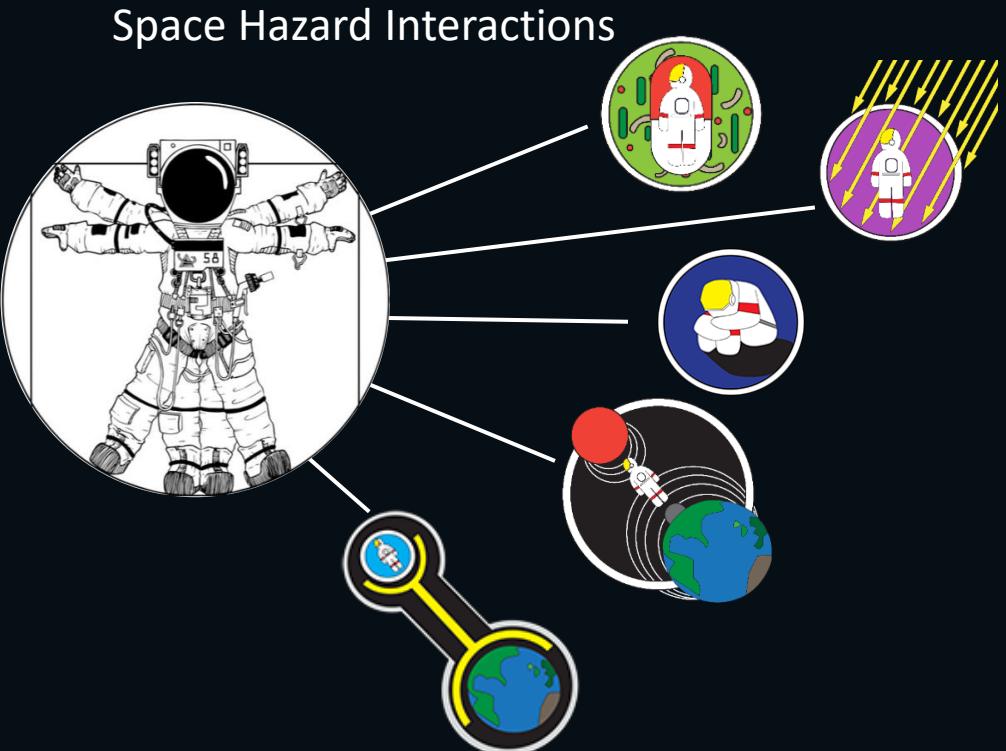
1/2



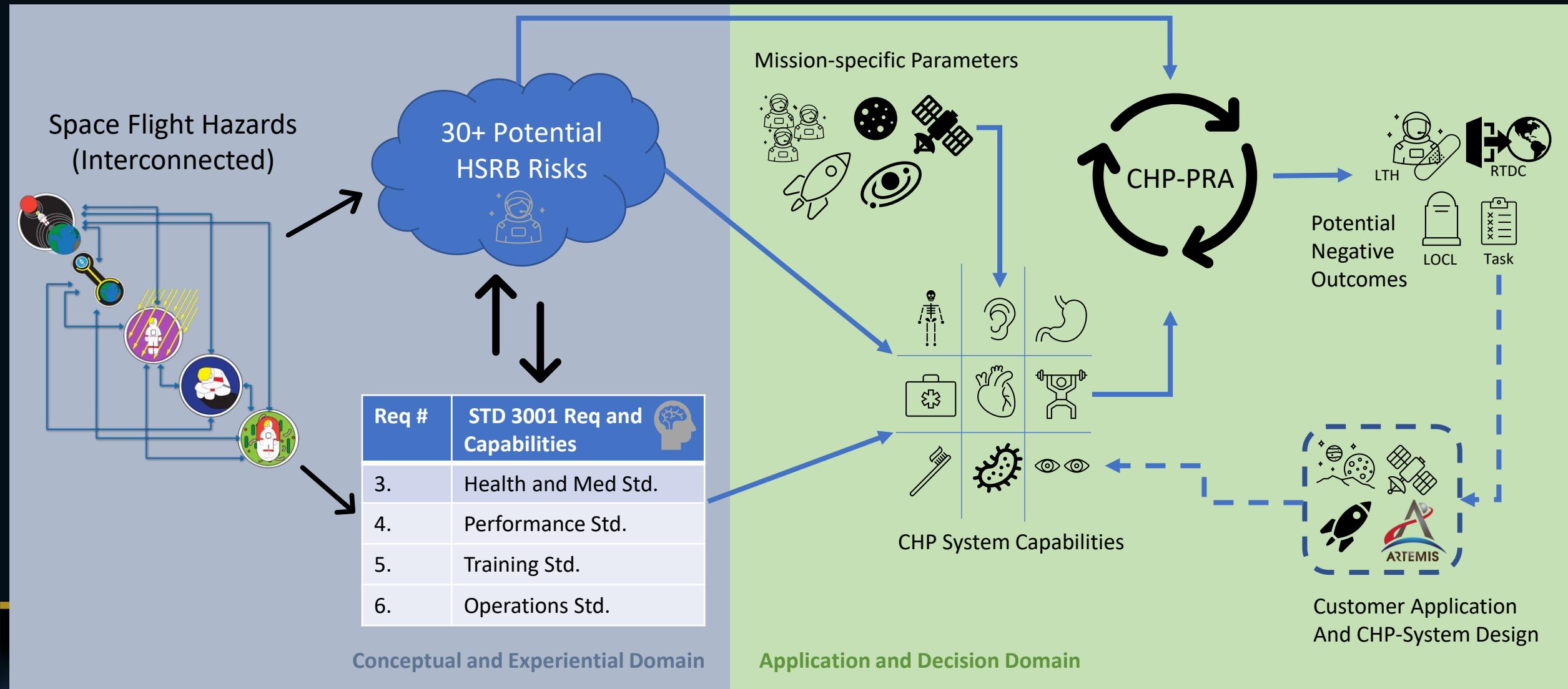
1/2



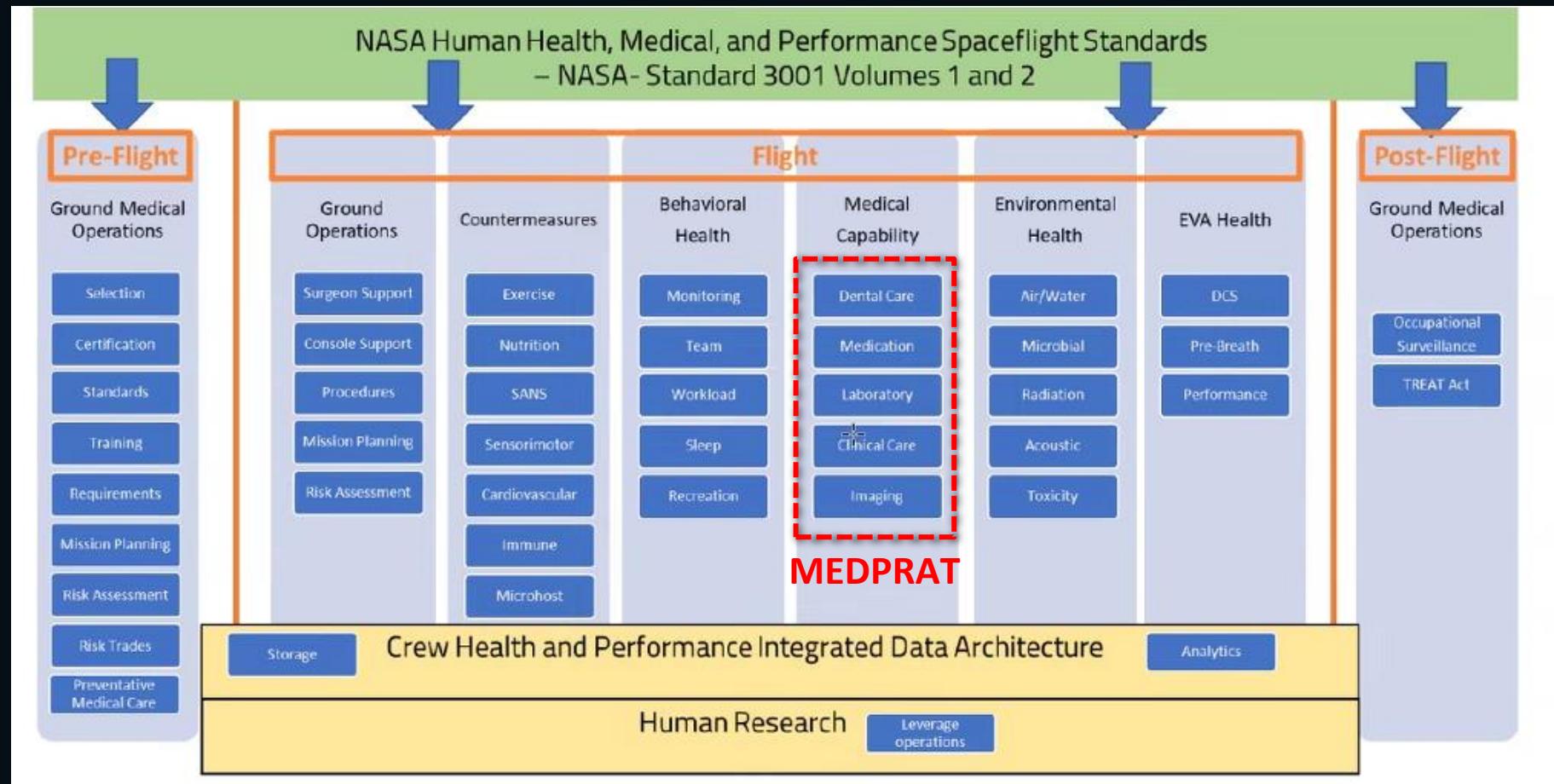
Many Factors to Weigh



Could Influence the Design Path

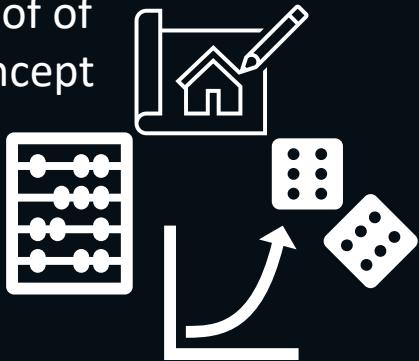


Crew Health & Performance System: HRP Mental Model

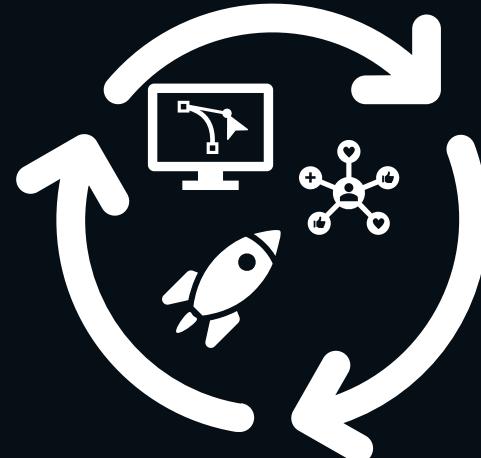


Reaching Our Goal

Proof of
Concept

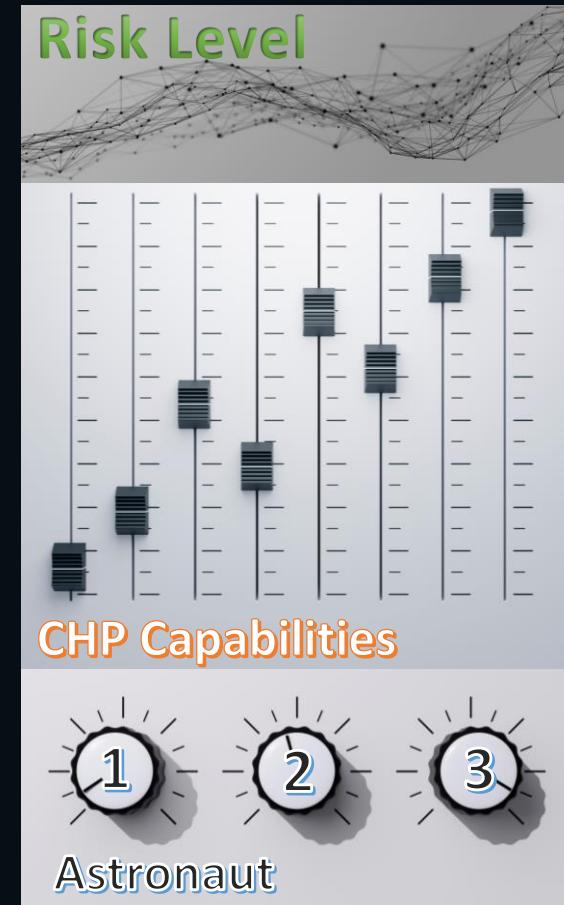


Comprehensive
PRA

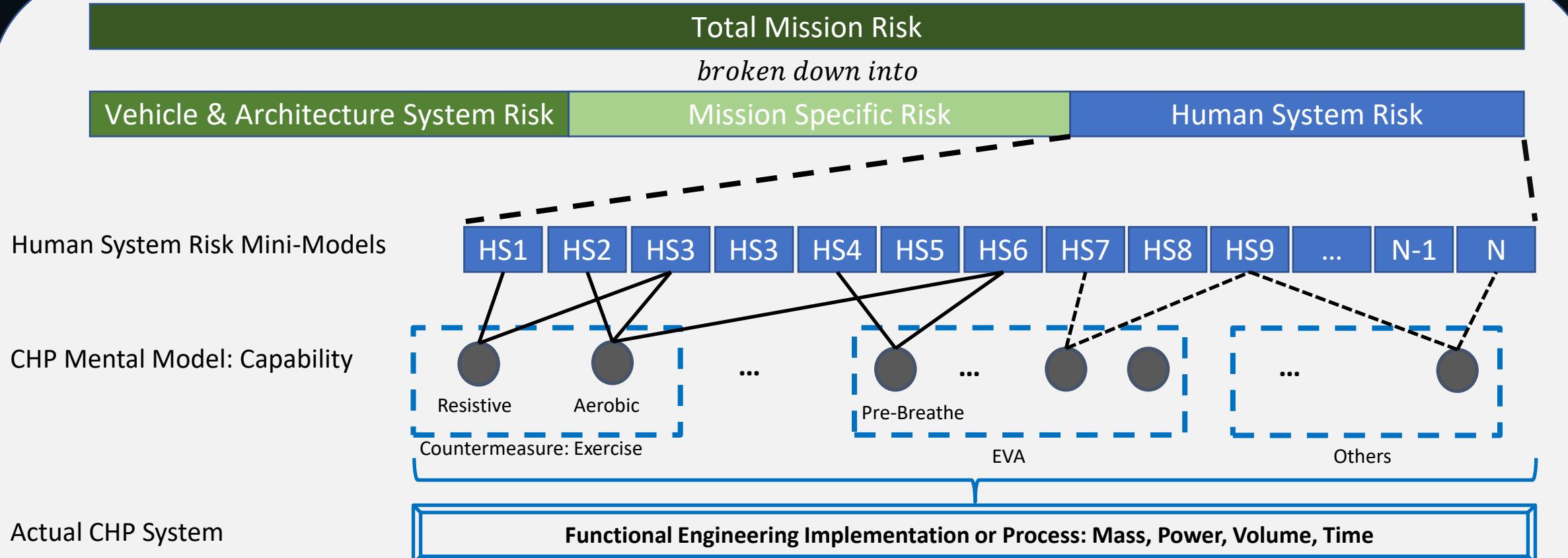


Developing a Crew Health and Performance PRA Capability

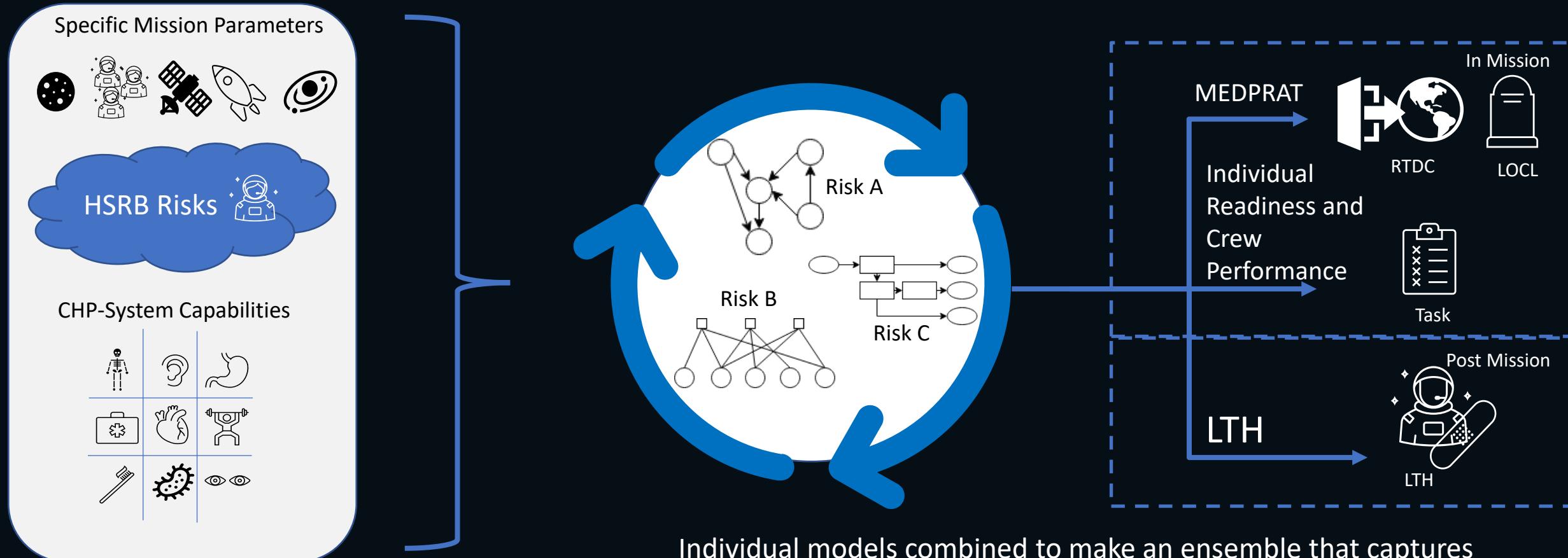
- “Comprehensive Model”
- “Series of Knobs”
- “Leverage HSRB DAGs”
- “Keep it Simple”
- Order of Magnitude Good Enough



Modest Cumulative Risk Approach

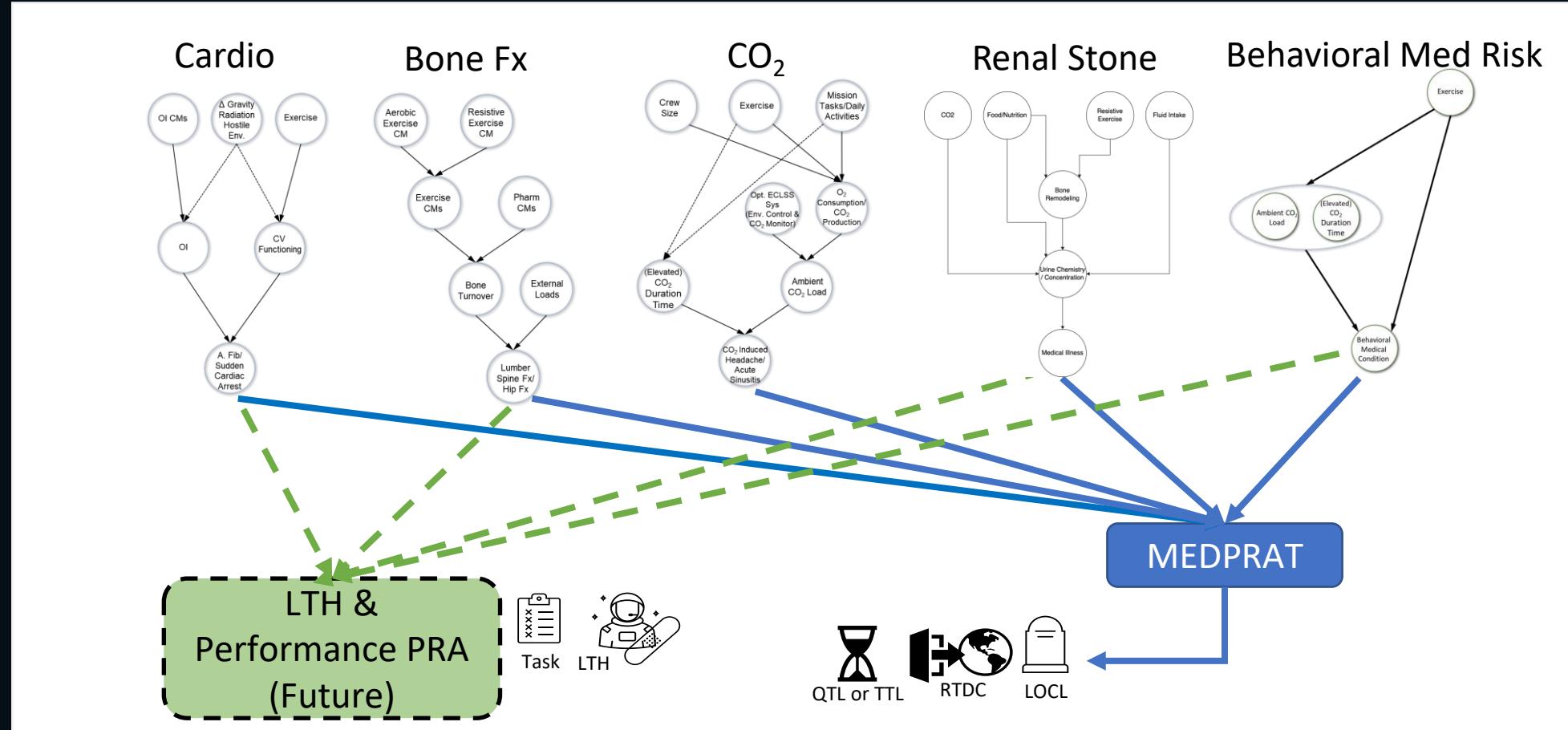
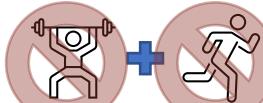
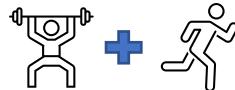


Strategy for an Early CHP-PRA Concept

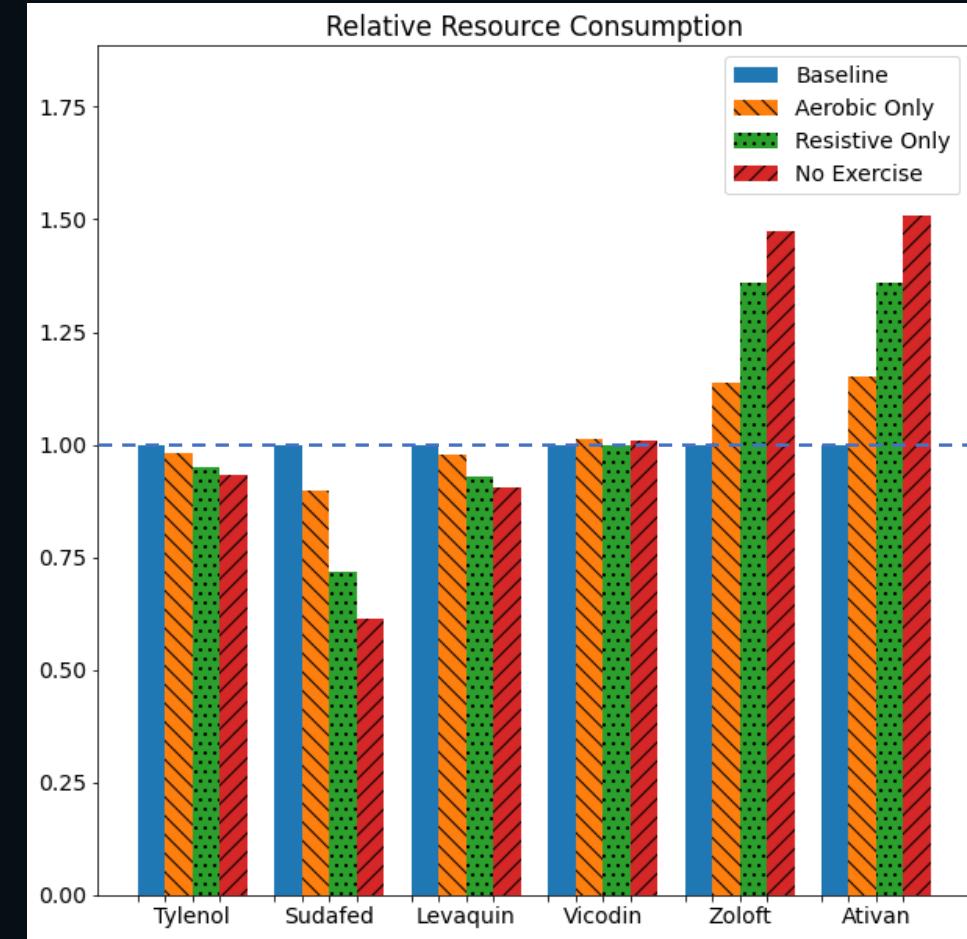
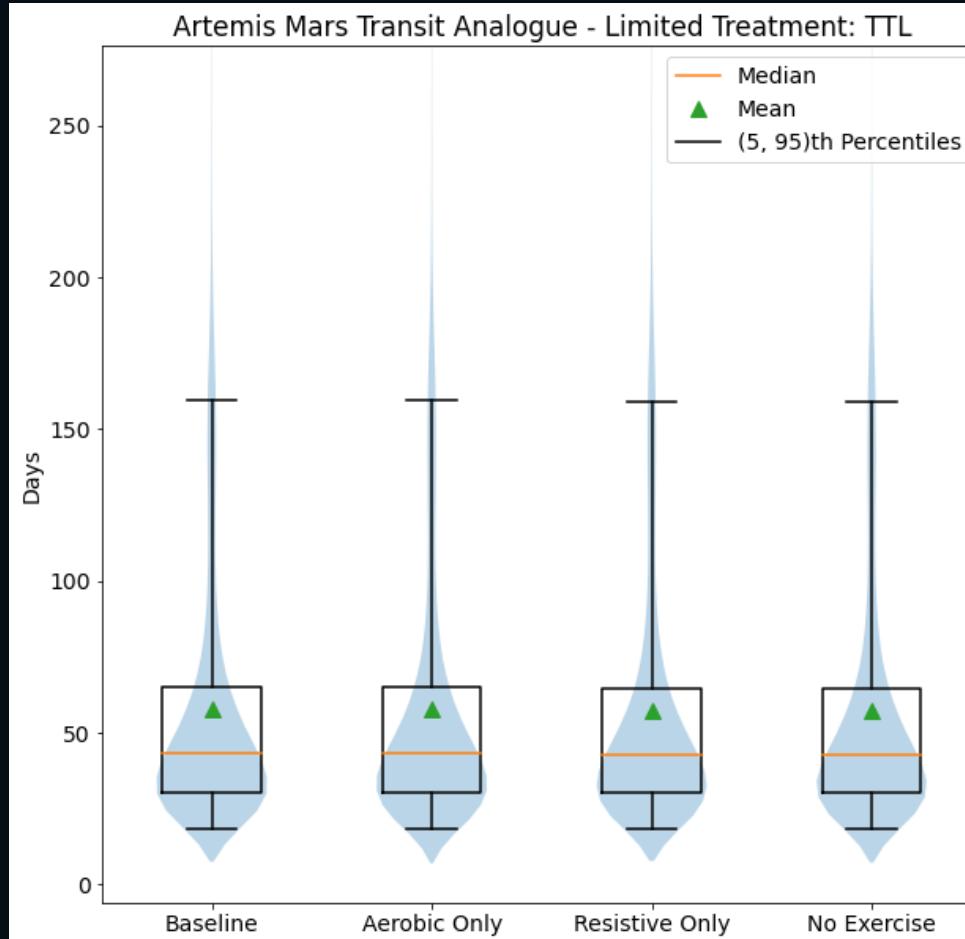


POC: Effect of Reducing a Capability to save M or V

Options for Evaluation



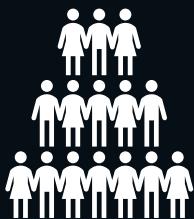
Mars Transit Analogue - Limited Treatment



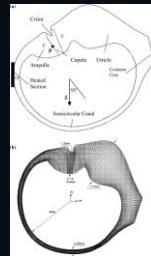
Collaborations, Integrations, and Next Steps



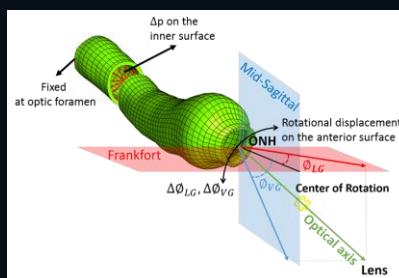
Radiation+ Long-Term Health Models



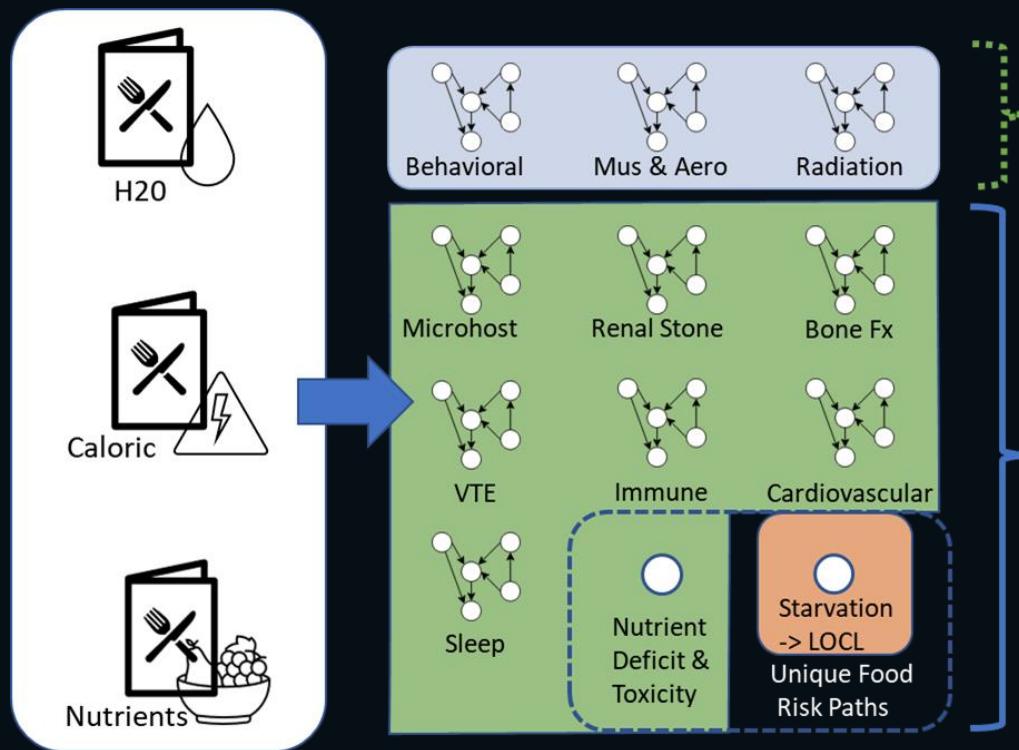
Agent-Based Models for Team and Behavior



Vestibular Performance Models



SANS and Cardiovascular Related Models



LTH and Performance PRA Tools

MEDPRAT

Long Term Health Efforts

LTH Metric Development TIMs with Stakeholders



beth.e.lewandowski@nasa.gov

https://www.nasa.gov/content/national-space-council-users-advisory-group/membership_roster_b_aldrin/

LTH Outcomes	LTH Risks
Cognitive impairment	Behavioral Medicine SANS
Long term psychological effects	Radiation carcinogenesis Behavioral Medicine SANS
Vision impairment	Dynamic Loads Non-ionizing radiation
Hearing impairment	Hearing loss
Early onset osteoporosis and/or debilitating arthritis	Bone Fracture
Musculoskeletal disability	Crew Egress Dynamic Loads
Skin constrictions	Electric Shock
Long term complications from spaceflight medical conditions	Medical
Long term complications from malnutrition	Food Renal stone
Kidney disease	Urinary Retention Electric Shock Toxic Exposure
Long lasting effects from DCS or arterial gas embolism	Decompression Sickness
Long lasting/debilitating rashes, autoimmune disorders	Dust Immune
Cancer	Radiation carcinogenesis Immune
Effects from untreated infections or sepsis	Microhost Urinary Retention
Chronic cardiopulmonary disease, Pneumoconiosis	Toxic Exposure Dust



Frequent Feedback Welcome



Questions ?

Jerry Myers – NASA GRC
jerry.g.myers@nasa.gov